

WHAT IS CLAIMED IS:

1. A retainer for holding an optical element,
the optical element according a center axis of the
5 optical element with a gravity direction, and having an
approximately rotationally symmetrical shape, said
retainer comprising:

a retaining member that includes three
support parts arranged at approximately 120° intervals
10 around the center axis, and holds the optical element
via the support parts; and

a joint member that joints the optical
element with the retaining member,

wherein $|(z_b - 0.6w_b) - (z_g + 1.2)| \leq 1$ is met,
15 where a Z coordinate system has an origin at an
intersection between the center axis and a surface of
the optical element, which surface faces a direction
opposite to the gravity direction, and sets a Z axis to
be positive in the direction opposite to the gravity
20 direction of the center axis, z_g is a coordinate of a
gravity center of the optical element in the Z
coordinate system, z_b is a coordinate of a center
position of a width of said joint member in the z axis
direction by which said joint member contacts the
25 optical element in the Z coordinate system, and w_b is
the width of said joint member in the z axis direction
by which said joint member contacts the optical element.

2. A retainer according to claim 1, wherein the optical element is a mirror.

3. A retainer according to claim 1, wherein said joint member is an adhesive.

4. A retainer according to claim 1, wherein said joint member is a comb-shaped spring.

5. A retainer according to claim 1, wherein said retaining member has an annular shape around the center axis of the optical member.

6. A retainer according to claim 1, wherein said joint member joints said retaining member around an entire outer peripheral of the optical element.

7. An optical system comprising:
an optical element that accords a center axis of the optical element with a gravity direction, and has an approximately rotationally symmetrical shape, and

a retainer for holding said optical element, wherein said retainer includes:

a retaining member that includes three support parts arranged at approximately 120° intervals

around the center axis, and holds the optical element via the support parts; and

a joint member that joints the optical element with the retaining member,

5 wherein $|(z_b - 0.6w_b) - (z_g + 1.2)| \leq 1$ is met, where a Z coordinate system has an origin at an intersection between the center axis and a surface of the optical element, which surface faces a direction opposite to the gravity direction, and sets a Z axis to
10 be positive in the direction opposite to the gravity direction of the center axis, z_g is a coordinate of a gravity center of the optical element in the Z coordinate system, z_b is a coordinate of a center position of a width of said joint member in the z axis
15 direction by which said joint member contacts the optical element in the Z coordinate system, and w_b is the width of said joint member in the z axis direction by which said joint member contacts the optical element.

20 8. An optical apparatus comprising:
 plural optical elements; and
 a retainer for holding at least one of said optical elements, which one accords a center axis of the optical element with a gravity direction, and has
25 an approximately rotationally symmetrical shape,
 wherein said retainer includes:

a retaining member that includes three support parts arranged at approximately 120° intervals around the center axis, and holds the optical element via the support parts; and

- 5 a joint member that joints the optical element with the retaining member,

 wherein $|(z_b - 0.6w_b) - (z_g + 1.2)| \leq 1$ is met, where a Z coordinate system has an origin at an intersection between the center axis and a surface of the optical element, which surface faces a direction opposite to the gravity direction, and sets a Z axis to be positive in the direction opposite to the gravity direction of the center axis, z_g is a coordinate of a gravity center of the optical element in the Z coordinate system, z_b is a coordinate of a center position of a width of said joint member in the z axis direction by which said joint member contacts the optical element in the Z coordinate system, and w_b is the width of said joint member in the z axis direction by which said joint member contacts the optical element.

10 the optical element, which surface faces a direction opposite to the gravity direction, and sets a Z axis to be positive in the direction opposite to the gravity direction of the center axis, z_g is a coordinate of a gravity center of the optical element in the Z coordinate system, z_b is a coordinate of a center position of a width of said joint member in the z axis direction by which said joint member contacts the optical element in the Z coordinate system, and w_b is the width of said joint member in the z axis direction by which said joint member contacts the optical element.

15 coordinate system, z_b is a coordinate of a center position of a width of said joint member in the z axis direction by which said joint member contacts the optical element in the Z coordinate system, and w_b is the width of said joint member in the z axis direction by which said joint member contacts the optical element.

20 by which said joint member contacts the optical element.

9. An exposure apparatus comprising:

a retainer for holding an optical element, the optical element according a center axis of the optical element with a gravity direction, and having an approximately rotationally symmetrical shape, said retainer including a retaining member that includes

25 optical element with a gravity direction, and having an approximately rotationally symmetrical shape, said retainer including a retaining member that includes

three support parts arranged at approximately 120° intervals around the center axis, and holds the optical element via the support parts, and a joint member that joints the optical element with the retaining member, wherein $|(z_b - 0.6w_b) - (z_g + 1.2)| \leq 1$ is met, where a Z coordinate system has an origin at an intersection between the center axis and a surface of the optical element, which surface faces a direction opposite to the gravity direction, and sets a Z axis to be positive in the direction opposite to the gravity direction of the center axis, z_g is a coordinate of a gravity center of the optical element in the Z coordinate system, z_b is a coordinate of a center position of a width of said joint member in the z axis direction by which said joint member contacts the optical element in the Z coordinate system, and w_b is the width of said joint member in the z axis direction by which said joint member contacts the optical element; and

an optical system for exposing a pattern formed on a mask or reticle onto an object via the optical element held by the retainer.

10. A device fabrication method comprising the steps of:
 - 25 exposing a pattern on a mask, onto an object by using an exposure apparatus; and
 - developing the object that has been exposed,

wherein said exposure apparatus includes:
a retainer for holding an optical element,
the optical element according a center axis of the
optical element with a gravity direction, and having an
5 approximately rotationally symmetrical shape, said
retainer including a retaining member that includes
three support parts arranged at approximately 120°
intervals around a center axis of the optical element,
and holds the optical element via the support parts,
10 and a joint member that joints the optical element with
the retaining member, wherein $|(z_b - 0.6w_b) - (z_g + 1.2)| \leq 1$ is met, where a Z coordinate system has an
origin at an intersection between the center axis and a
surface of the optical element, which surface faces a
15 direction opposite to the gravity direction, and sets a
Z axis to be positive in the direction opposite to the
gravity direction of the center axis, z_g is a
coordinate of a gravity center of the optical element
in the Z coordinate system, z_b is a coordinate of a
20 center position of a width of said joint member in the
z axis direction by which said joint member contacts
the optical element in the Z coordinate system, and w_b
is the width of said joint member in the z axis
direction by which said joint member contacts the
25 optical element; and

an optical system for exposing a pattern formed on a mask or reticle onto an object via the optical element held by the retainer.